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of fresh porphyritic rocks which extend westward from the town of East Greenwich, although the Cambrian and Carboniferous sedimentaries and the various Paleozoic igneous rocks of this difficult area are not neglected. A complex collection of igneous rocks was intruded into the Cambrian schists, in Carboniferous times or earlier, as a laccolithic mass. A narrow basic border on the northern side of this mass passes on the south into a broad band of the granitic nucleus, while still farther south are extensive microgranites and graphic microgranites. The microgranites and the basic rocks of the narrow border seem to be portions of a common mantle over the granite. Fragments of the graphic microgranite in a blue quartz-porphyry cement constitute a breccia in the central area. After the consolidation of the granite and the rocks of its mantle, microgranite dikes penetrated the mass; then an explosive eruption blew off this microgranitic capping and furnished the numerous fragments of that rock found in the adjacent Carboniferous conglomerate. A portion of the magma left in the conduit solidified to form the central mass of porphyry; while another part, already partially crystallized, cemented shattered fragments of the graphic microgranite when a sudden transference to a higher level caused a rapid consolidation. In the comparatively quiet period following this eruption, the Carboniferous conglomerates containing bowlders of these igneous rocks were spread still more widely over the region. The conglomerates afterward suffered considerable metamorphism, so that their paste was converted into a coarse muscovite schist and many secondary minerals were developed. The publication of this bulletin will go a long way toward clearing up the very complex geological history of Rhode Island.

H. H.

Some Principles of Seismic Geology. The Geotectonic and Geodynamic Aspects of Calabria and Northeastern Sicily. By William Herbert Hobbs. Sonderabdruck aus Gerlands Beiträgen zur Geophysik. Bd. VIII, Heft 2, s. 219–362. Leipzig: Wilhelm Engelmann, 1907.

The author of these two articles, in an endeavor to gain more light on the crustal architecture of regions like the New England states, was on his way to Calabria when the disastrous earthquake of 1905 occurred in that province. His observations were thereby greatly facilitated. The first monograph deals in a broad way with seismic phenomena and their relation to certain geological problems. Data gathered from the communes damaged by earthquakes leads to the conclusion that they are usually arranged along essentially straight lines which bear some relationship to geologic boundaries, coast lines, mountain borders, etc., which are parallel to one another in series, and which often intersect volcanic vents. Seismic intensity does not vary with distance from any point or points within the earth, but is greatest at or near the intersections of these seismotectonic lines. In only a very few cases can seisms be said to owe their origin to vulcanism; the great majority of shocks are due to faulting of the normal type and it is along fractures that the earth-waves are propagated. Places situated even a short distance from fracture lines along which disturbances have repeatedly occurred have escaped serious injury. It is interesting to note also that brontidi, the deep rumblings heard commonly in certain localities, occur on lines along which much seismic disturbance has taken place, indicating that these noises are due to slipping along fracture planes. A survey of recorded earthquake scarps and fissures seems to show that notable surface dislocations are formed only at times of notable shocks; that they are sharply divided into two orders of magnitude; that the faults are of the nearly vertical normal type, and that all the movements are due to an adjustment in position of individual blocks. Thus a careful study of the earth movements of a region may furnish data from which the position of otherwise undeterminable fault planes and systems may be derived. The topography and hydrography of many areas is also modified along seismotectonic lines, as is illustrated in the United States by the Northern and Southern Fall lines, the Carolina coast line, the Connecticut line, and other lineaments. The three most prominent seismic areas of the United States—the Atlantic border, the middle Mississippi basin, and the bay of San Francisco—are also sinking areas. Briefly stated, the law of the distribution of seismic phenomena is that seismicity is localized along faults and is greatest at their intersections.

The second article deals more in detail with the southernmost portion of the Italian peninsula and with the neighboring parts of Sicily. In this region the relationship between the topography and crustal dislocations is particularly well marked and the rectilinear stretches of coast are often lines of great seismicity. Even the separation of Sicily from Calabria and from Africa is a comparatively recent event due to subsidence along fault planes. The well-known Italian volcanic vents are often situated at the intersections of fracture planes, while the destructive intensity of Calabrian quakes is greatly augmented at similar points. A striking fact in connection with the best-known earthquakes of Calabria is the nearly constant relative intensity shown at a number of the affected communes, indicating that these shocks have been the results of successive slippings along the same fault planes or that the elastic waves have been transmitted mainly along these planes. Adjustments of smaller amplitude have occurred along other planes but in no case is there any evident relation to an epicenter. H. H.

Drumlins of Central Western New York. By H. L. FAIRCHILD. New York State Museum, Bulletin 111; 76 pp., 20 pl., map. Albany, 1907.

New York possesses the most remarkable group of drumlins in the world, and this bulletin, with its excellently prepared maps, photographs, and descriptive matter, will be a welcome addition to a glaciologist's library. The distribution of the New York drumlins shows that they were formed during the latest phase of glaciation by the spreading of the ice from the Ontario basin. A sliding movement of the lower ice caused by a horizontal thrust from behind seems to be essential to drumlin formation, though the quality, position, and volume of the drift material, and the degree of the vertical pressure and of the mobility of the ice are also factors. The shales of central New York furnished a peculiarly adhesive drift from which the drumlins were *constructed* by a plastering-on process. These masses of drift were thus given their peculiar shapes by the rubbing action of the ice movement during the final stages of diminished pressure and lagging flow. The presence of open spaces in the midst of strongly drumlinized areas is difficult of explanation. In some cases depressions may have lain at such a low level that a plane of shearing was formed in the ice above them so as to leave a mass of stagnant ice beneath. An earlier ice invasion may have localized the drift of the ground moraine that was to be shaped into drumlins by the next invasion; but no drumlin was observed, the internal structure of which revealed a direct derivation from terminal moraine material.

H. H.

Geology and Water Resources of the Bighorn Basin, Wyoming. By CASSIUS A. FISHER. U. S. Geological Survey, Professional Paper, No. 53; 51 pp., 20 pl., map. Washington, 1906.

The region described comprises about 8,500 square miles, situated mainly in Bighorn County in northwestern Wyoming. The most striking topographic feature is a broad structural valley bounded on nearly all sides by high mountain ranges and containing in its interior high badland slopes. The amount of water in the principal streams varies greatly with the season of the year, being greatest in early summer; but irrigation has been prac-